Recrystallization kinetics of calcite, morphology controls, and the influence of Eu^{3+} and SeO_3^{2-}

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Calcite is ubiquitious in natural environments. Adsorption of contaminants at the calcite surface may retard the transport of these chemical species through the pedo- or geosphere. Spontaneous recrystallizatioin of calcite may even lead to the structural incorporation of the trace elements into the calcite structure. This mechanism may constitute a major sink for contaminants, even at calcite saturated conditions where coprecipitation cannot take place. A fundamental understanding to what extent calcite recrystallizes during a given time, the mechanisms and the kinetics involved, and the interplay between these mechanisms and trace element incorporation is therefore one key issue if one wants to predict the fate and transport of contaminants in the geosphere.

The results of batch type recrystallization experiments measured by $^{45}Ca^{2+}$ isotope exchange, using various calcite powders will be presented. They show that recrystallization rates depend strongly on particle size, morphology and roughness of the used calcite. The rates vary from some monolayers recrystallization during three month to full recrystallization of the particles within 24 hours.

Eu^{3+} is known to sorb strongly at the calcite surface [1] and to be readily incorporated into the calcite structure [2]. It has hardly any influence on the recrystallization kinetics. Our results allow the precise determination of a partition coefficient for Eu^{3+} in calcite (D= 642±1).

Structural incorporation of SeO_3^{2-} into calcite is energetically very unfavourable [3]. The change in the lattice constants induced by SeO_3^{2-} entrapment in calcite are evaluated based on surface diffraction data. The high energy cost of SeO_3^{2-} incorporation into calcite is in line with the retardation of calcite growth as observed in previous AFM [4] and batchtype [3] experiments. However, the recrystallization kinetics of very rough ground calcite is not influenced by the presence of 10^{-6} mol/L of SeO_3^{2-}. This is interpreted as an indication that the calcite growth retardation by SeO_3^{2-} depends on the growth mechanism.

[1] Piriou et al. (1997), *JCIS*, **194** [2] Marques-Fernandez et al. (2008), *JCIS*, **321** [3] Heberling et al. (2014), *GCA*, **134** [4] Renard et al. (2013), *Chem. Geol.* **340**